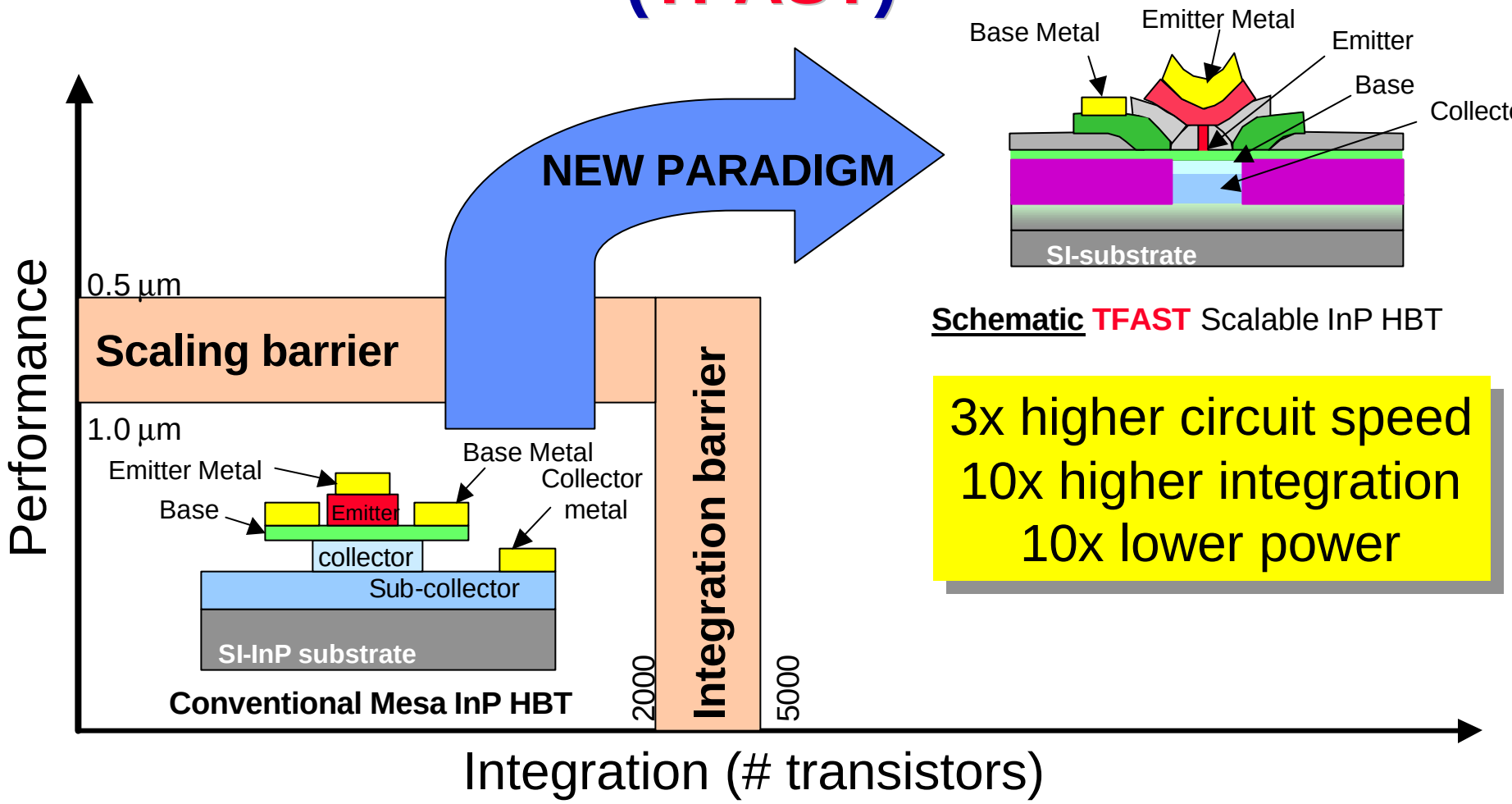
Technology for Frequency Agile Digitally Synthesized Transmitters (TFAST)



Schematic TFAST Scalable InP HBT

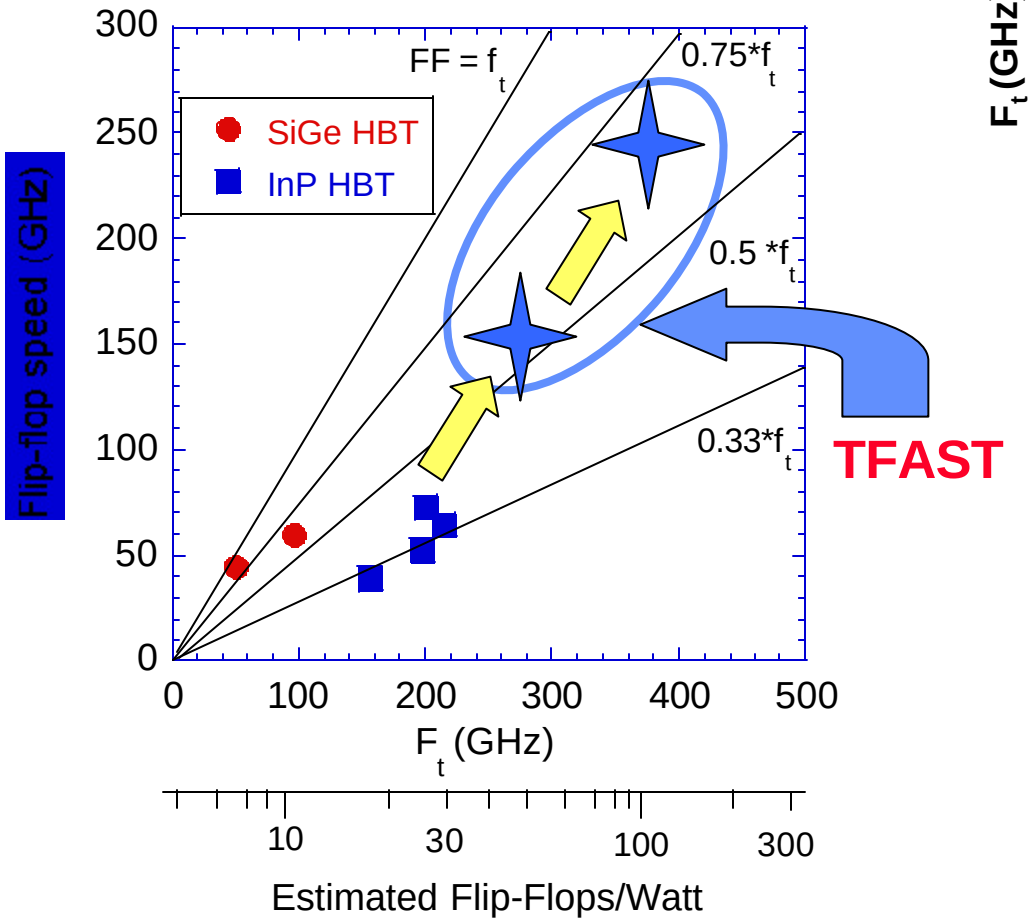
3x higher circuit speed
10x higher integration
10x lower power

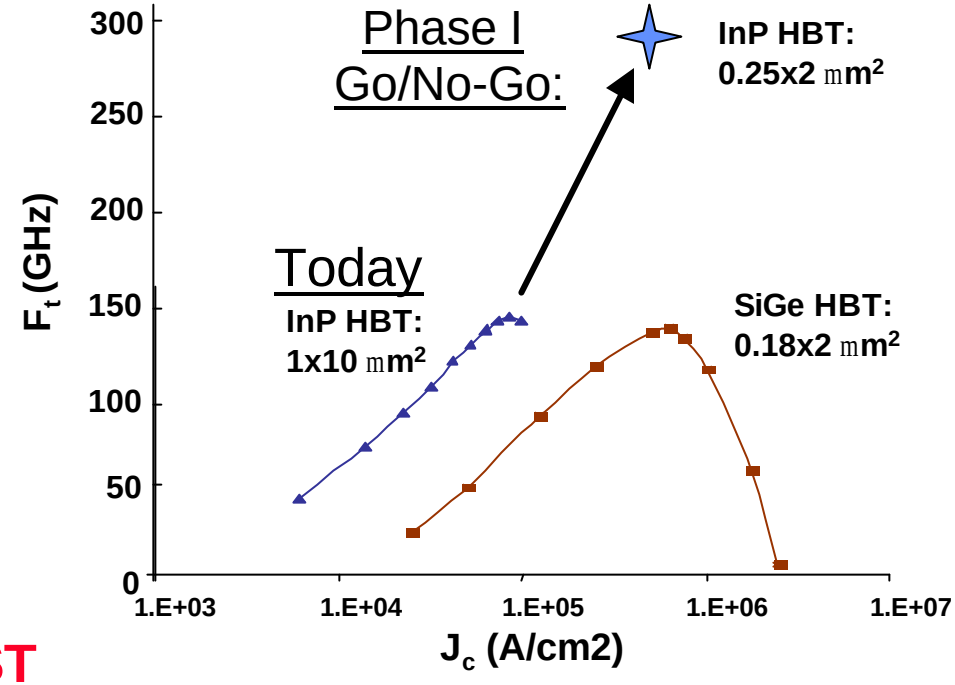
Concept Briefing to Industry

John C. Zolper
DARPA/MTO
703-696-7039
jzolper@darpa.mil

TFAST: Super Scaled InP HBT Technology

Static Flip-Flop is building blocked for mixed signal circuits





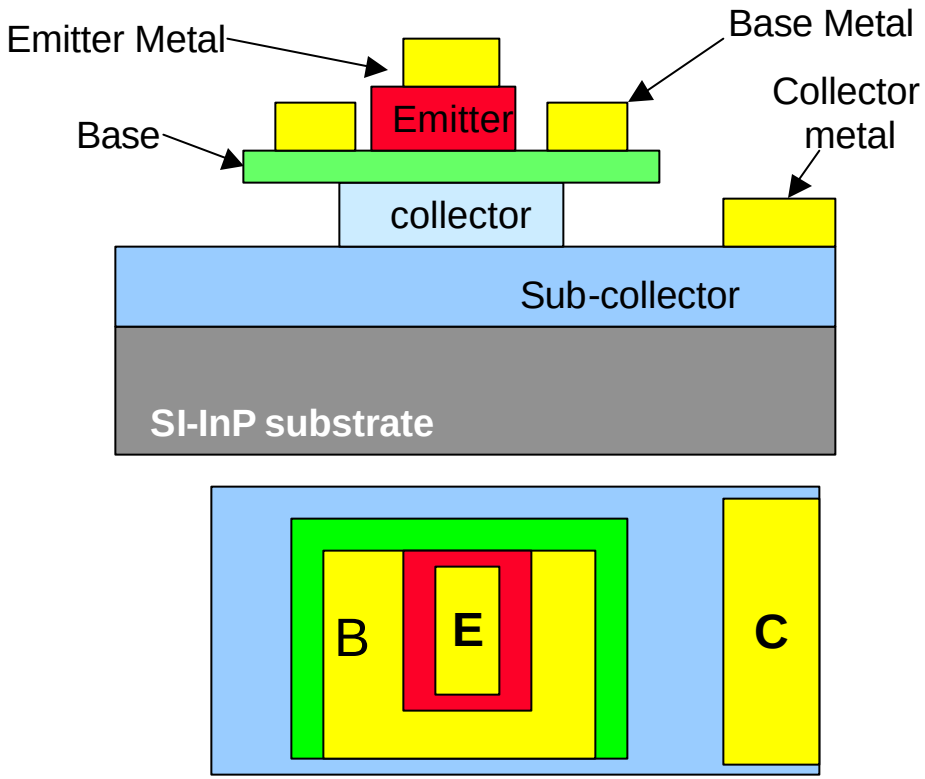
Mixed Signal Transistor Figure of Merit:

$$(1)\ f_t,\ f_{\max} \qquad (2)\ \frac{J_C V_{CEO}}{C_{cb}\Delta V_{LOGIC}}$$

Current InP Mesa HBT circuit performance is limited by scaling and integration

InP HBT Present Technology

Mesa HBT today



+ Low capacitance
+ Low base resistance

- Inherent limitation on minimum feature size
- Poor thermal dissipation
- Limited emitter contact
- Limited current capability
- Process limits integration

Potential Phase I Milestones

Metric	today	18 month Go/No-Go	TFAST Goals
Emitter width (μm)(1)	1.0	0.25	0.15
f_t/f_{max} (GHz)(1)	200/200	350/400	500/500
J (kA/cm^2) (at fixed V_{CE})(1)	200	600	1000
Flip flop speed (GHz) (at fixed power)	75	150	250
SSI circuit validation		TBD	TBD
Integrated transistor count and yield (current InP mesa HBT: ~2000, ~50% yield)	0 (super-scaled HBT)	1000 Identify yield limiters(2)	>20,000 quantify yield limiters(2)

(1) must be achieved simultaneously and with $V_{ceo} \geq 4V$
(2) will establish critical metrics for Phase II

TFAST Application Impact (Phase II): mmWave Direct Digital Synthesis Mixed Signal Circuits

- Agile, reconfigurable mm-wave transmitters
- 10 times lower power at current performance
- Higher dynamic range via more complex circuits with higher output voltage
- In-combat programmable Electronic Warfare jammers
- Covert mm-wave frequency hopping Comms
- In-flight reprogrammable SATCOMM links
- Reduced parts count and stability with digital versus analog frequency generation (reduced analog tuning required)

Additional Applications

- Core mixed signal technology will also enable high performance ADC
- Technology push should considers ADC as well as DDS type application where possible